

DESCRIPTIONS OF NEW SPECIES OF PARASITIC COPE-
PODS IN THE COLLECTIONS OF THE UNITED STATES
NATIONAL MUSEUM.

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INTRODUCTORY.

The species described in the following paper were obtained from different sources, the first two from the American Museum of Natural History of New York City, and the last three from the United States National Museum. The two former were sent to the author for identification. After it had been determined that they represented new species of *Argulus* and *Achtheinus*, respectively, the American Museum very courteously allowed duplicates to be selected from them and deposited in the National Museum to serve as cotypes of the species. The other three species were all taken from the gills of a single fish, a *Polynemus tetradactylus*, from Batavia, Java, from the collection of the United States National Museum. These three belong to the genera *Caligus*, *Parapetalus*, and *Lernanthropus*, respectively. The first of these had been very imperfectly described and figured by Bassett-Smith, the second was wrongly referred by the same author to the genus *Caligus*, while the third is new to science. A brief record is here introduced of the finding, on the California coast, of another species, *Achtheinus dentatus*, which had previously been recorded only from South America.

In all, therefore, the present paper deals with six species, of which three are new.

DESCRIPTIONS OF NEW SPECIES.

ARGULUS INGENS, new species.

Plates 30 and 31, fig. 7.

Female.—Carapace elliptical, one-sixth longer than wide; anterolateral sinuses sharply defined but not very deep; posterior sinus narrow, two-fifths the length of the carapace, with parallel sides; lobes not quite reaching the abdomen and narrowed posteriorly, but covering all of the swimming legs except the very tips.

Respiratory tracts of peculiar shape, as shown in figure 5, the smaller tract a perfect circle, 1 mm. in diameter, set into the inner side of the larger one; the latter made up of an anterior circular area the same size as the small area, a narrow neck around the latter, and an elongate posterior portion, abruptly widened into a triangle with rounded corners and with a triangular incision on its anterior margin just behind the small area.

Abdomen broadly ovate, one-half the length of the carapace, the base projecting forward as a broadly rounded lobe on either side of the last thorax segment, so as almost to meet the carapace lobes; anal sinus triangular, four-sevenths the length of the abdomen, with triangular and acuminate lobes; papillæ lateral, at the center of the sides of the sinus, linear and each tipped with three small setæ.

Sucking disks, each one-fourth the width of the carapace, situated far forward and so close together that their inner margins almost touch; supporting rays of the margin made up of a series of oblong rods placed end to end and diminishing regularly and rapidly in size outward (see fig. 6).

There are two small tactile papillæ just behind the opening of the oviduct, their convex sides touching on the midline, their anterior ends enlarged into circular pads.

Antennæ of medium size, the first pair with comparatively small claws on the basal joint, the three terminal joints very slender and scarcely reaching beyond the tip of the basal joint; second pair long and slender, armed with only a few minute spines on the two terminal joints, but with a large and sharp spine just behind the base of the proximal joint. Maxillipeds stout, the terminal joint small and tipped with three tiny claws, the third joint with a broad lamellar process on its ventral surface near the proximal end, the basal joint with a triangular plate, whose two outer teeth are close together and at some distance from the inner one, all the teeth of medium length and acuminate.

There are two pairs of accessory spines close to the midline opposite the bases of the maxillipeds. All four pairs of swimming legs are furnished with flagella, and the bases of the fourth legs are produced into boot-like tactile processes not quite reaching the lateral margins of the abdomen. The mouth-tube is long and narrow with the opening on the ventral surface and singularly square in outline.

Male.—General shape similar to that of the female, but the anterior margin of the cephalic area projects much more strongly, the lateral lobes of the carapace are much longer, overlapping the abdomen considerably and leaving a much narrower posterior sinus. The anterior corners of the abdomen are produced into narrow knobs or processes, extending forward and outward. In the accessory sexual organs the basal joints of the first legs are produced backward and

fringed with a dense row of long fine hairs; the proximal joint of the second legs has a lunate process on the ventral surface near the distal end, the two ends of the process curving over ventrally toward each other; the proximal joint of the third legs has a finger-like process at the distal anterior corner and a dense tuft of fine hairs opposite on the posterior margin; the fourth legs have the usual peg on the anterior distal margin of the basal joint, while the boot-like process is fringed with long and very fine hairs (see fig. 4).

The accessory sexual apparatus is thus more complicated than usual and is peculiar for the abundance of dense hair fringes.

Color (preserved material, both sexes) a uniform yellowish brown, marked with small spots of darker brown over most of the carapace and the center of the abdomen.

Total length of female, 21.5 to 25 mm.; of male, 16 mm. Carapace of female, 14.5 mm. long, 12.5 mm. wide. Abdomen, 7 mm. long, 5.5 mm. wide. Carapace of male, 12 mm. long, 9 mm. wide.

(*ingens*, of very large size.)

This species can be recognized by its great size, by the approximation of the two outer spines on the basal plate of the maxilliped, and by the complicated accessory sexual apparatus of the male, particularly by the dense hair fringes. This is by far the largest American species, and the only foreign species that surpasses it is *A. scutiformis* Thiele, the female of which is sometimes 30 mm. long.

Two females and a male of this species were obtained by the American Museum of Natural History, through Dr. L. Hussakof, from the mouth of the alligator gar, *Lepisosteus tristæchus* (Bloch and Schneider), in Moon Lake, Mississippi. The male and one female are made the types of the species and are retained by the American Museum. The other female becomes a cotype in the National Museum with Cat. No. 42290, U.S.N.M.

ACHTHEINUS PINGUIS, new species.

Plate 31, figs. 8-14, and plate 32, figs. 15-21.

Female.—General form more like that of *Perissopus* than either of the species hitherto described. Carapace trapezoidal, widest across the posterior border, considerably narrowed anteriorly, with nearly straight sides.

Frontal plates thoroughly fused with the head, their anterior margin entire and evenly rounded, with a shallow sinus at the center.

Posterior margin of carapace with flattened curves, somewhat reentrant at the center; posterior sinuses shallow and narrow, posterior lobes short and blunt; lateral areas narrow, with the transverse grooves practically obliterated, appearing only as slight notches on the lateral margins. Dorsal plates covering the fused second and third thorax segments, of the same width as the carapace, elliptical, sepa-

rated to their very bases and not quite meeting on the midline. Dorsal plates on the fourth segment ovate, widened posteriorly so as just to meet, one-eighth wider than the first pair and projecting behind the latter only one-fifth of their length.

Genital segment one-fourth wider and longer than the carapace, with strongly convex sides and well-rounded posterior corners; posterior sinus wide and deep, with nearly parallel sides.

Abdomen one-jointed and triangular, much wider than long, with a narrow, slit-like posterior sinus; anal laminæ broad, strongly flattened, widely separated, and not reaching the posterior margin of the genital segment, each tipped with three minute spines.

At the base of the abdomen on either side is a small accessory lobe which doubtless represents the rudiments of the sixth segment.

The egg strings are relatively narrow, and give evidence of being quite long, though no unbroken ones have as yet been obtained; the eggs are exceptionally thin and very numerous.

Basal joint of the first antennæ swollen, considerably wider but shorter than the terminal joint, both joints sparsely armed with setæ.

Second antennæ stout, the terminal claw strongly curved; maxillæ in the form of flattened plates on either side of the base of the mouth tube. In the maxillipeds the pad on the basal joint is large and swollen, the terminal claw is long and stout and fits into a depression in the pad near its inner end (see fig. 16).

All four pairs of legs are small and rudimentary and destitute of plumose setæ, but they are distinctly biramose, the rami of the first three pairs two-jointed, with the joints about equal in size, of the fourth pair one-jointed, with minute spines on the exopod only.

Just outside of each exopod there is a small papilla tipped with a short and weak spine. The fifth legs are in the form of long and narrow papillæ projecting from the ventral surface of the posterior lobes, each tipped with a single short spine. Cement glands similar to those of *oblongus*, but relatively larger, and with the divisions more plainly visible (see fig. 21).

Total length, 5.75 mm. Carapace, 2.33 mm. long, 2.4 mm. wide. Both pairs of dorsal plates 1.2 mm. long, first pair each 1.2 mm. wide, second pair each 1.4 mm. wide. Genital segment, 3 mm. long, 3.1 mm. wide. Egg strings, 0.3 mm. wide and at least 8 mm. long.

Male.—A *Nogaus* form, short and thickset. Carapace horseshoe-shaped, three-sevenths of the entire length, and including the lobes a little longer than wide, with a squarely truncated posterior margin. Frontal plates distinct, separated from the carapace by well-defined grooves, narrowed to a point on the median line, but increasing in width toward the lateral margins, where each ends in a rounded lobe projecting over the base of the antenna; a well-defined but shallow sinus on the median line between the plates. Lateral areas narrow,

with the transverse groove considerably posterior to the center. Posterior lobes long, narrowed posteriorly, and curved slightly inward, projecting over two-thirds of the length of the fused second and third thorax segments, and bordered with an exceptionally wide transparent margin.

Eyes separated, placed well forward, and arranged in a semicircle, the median one posterior.

Second and third thorax segments fused, with only a faint dorsal groove to indicate the union, and no rounding of the anterior corners of the third segment. These fused segments are three-fifths the width and half the length of the carapace, with a good-sized lobe projecting from the lateral margin on either side near the center, which represent the lobes commonly found at the posterior corners of the second segment in *Nogaus* forms. Fourth segment free, three-fifths of the width of the fused segments, with both the anterior and posterior corners rounded in the usual manner.

Genital segment the same length and width, which is seven-ninths the width of the fourth segment, narrowed anteriorly and posteriorly with a slight protuberance on each lateral margin near the posterior end.

Abdomen triangular, two-thirds the width of the genital segment and nearly twice as wide as long; anal laminæ small and semicircular, each armed with four plumose setæ of about the same length.

Appendages similar to those of the female, except for the usual sex modifications.

Maxillipeds with a second large claw in place of the pad borne by the female, the two claws shutting past each other like a pair of scissors. Swimming legs with plumose setæ as well as spines and with a small spine on the basal joint outside of each exopod.

Total length, 3 mm. Carapace (including posterior lobes), 1.75 mm. long, 1.62 mm. wide. Fused segments, 0.62 mm. long, 1 mm. wide. Genital segment, 0.5 mm. long and wide. Color (preserved material), a uniform cinnamon brown, becoming lighter and yellowish in the thinner portions of the carapace.

(*pinguis*, stout, plump.)

This is the first male to be described for the genus *Achtheinus*, and as it establishes a new genus type among the *Nogaus* forms we may make for it the following diagnosis, corresponding to those already established for other genera: ¹

Genus *Achtheinus* (male).—Carapace large horseshoe-shaped, without conspicilla or accessory lobes. Genital segment not enlarged; two pairs of legs visible dorsally; abdomen one-jointed, triangular; anal laminæ very small and semicircular; legs all biramose, rami of first three pairs two-jointed, of fourth pair one-jointed; maxillæ broad and

lamine; maxillipeds moderately swollen, with two stout claws, shutting past each other like scissor blades.

Achtheinus pinguis, new male type.

This species is readily distinguished from *oblongus* by the shorter and wider carapace, by the separation of the two pairs of thoracic plates to their very base, by the great enlargement of the genital segment in the female, and by the accessory lobes at the base of the abdomen. It differs from *dentatus* in its relatively shorter and plumper form, in the fact that the carapace is as wide as the two pairs of thorax plates, in the shape of the posterior sinus of the genital segment, and in the fact that its second antennæ are not toothed.

Three females and two males were obtained by the American Museum of Natural History through Dr. L. Hussakof from the pectoral fin of a sawfish, *Pliotrema warreni*, off the Cape of Good Hope in 40 fathoms of water.

Two of the females and one male become the types of the species and are retained by the American Museum, the other male and female are made cotypes and are deposited in the United States National Museum under Cat. No. 42302, U.S.N.M.

ACHTHEINUS DENTATUS Wilson.

Achtheinus dentatus WILSON, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 630, pl. 67.

Another finely preserved female of this species has been taken from the tail of one of the cow sharks, *Notorhynchus maculatus*, on the California coast. It has been given Cat. No. 42274, U.S.N.M., and is worthy of record because it was obtained from a new host and one which is common on our own western coast. This makes the species North American, although the types were obtained off the coast of Peru in South America.

CALIGUS PHIPSONI Bassett-Smith.

Caligus phipsoni BASSETT-SMITH, Ann. and Mag. Nat. Hist., ser. 7, vol. 1, p. 7, pl. 3, figs. 3 and 4.

Plate 32, fig. 22, and plate 33, figs. 23 to 27.

Both sexes of this species were obtained by Smith from the inner surface of the gills of *Cybium guttatum* at Bombay and were described in the above-mentioned paper. Since his text and figures do not agree in several particulars, and since his description omits some of the most important characters, the following notes are here presented as supplementary. They are based upon specimens taken from the gills of *Polynemus tetradactylus*, at Batavia, Java, by Dr. Owen Bryant and Mr. William Palmer. These specimens have been placed in the National Museum and numbered 42304, U.S.N.M.

Smith states that his species "resembles *C. irritans* Heller, but differs in having the cephalothorax rather broader, the furcula larger, the abdomen single-jointed, and in the arrangement of the bristles on the caudal plates."

With the exception of the jointing of the abdomen, these differences are varietal rather than specific, nor do Smith's figures add anything further. But the female of *phipsoni* has a maxillary hook so small that it was entirely overlooked by Smith, while in *irritans* the hook is nearly as large and prominent as the second antennæ. In *phipsoni* the first maxillæ are broadly triangular, destitute of the rudimentary exopod, and do not reach the tip of the mouth tube; in *irritans* they are abruptly narrowed close to the base; they have a large rudimentary exopod, and they reach far beyond the tip of the mouth tube.

This latter is relatively very much wider in *irritans*, and the chitin framework is altogether different in the two species.

In the male *phipsoni* the maxilliped is scarcely larger than that of the female and no different; in *irritans* the maxilliped of the male is greatly enlarged, and its basal joint is armed with two or three wicked spines or catches, into which the terminal claw shuts.

The third legs of the two species differ in size, shape, and the number and arrangement of the plumose setæ and spines. In *phipsoni* the rami of these legs are so widely separated and project so little from the basal apron as to be invisible in dorsal view; in *irritans* they are quite prominent and much closer together. In the fourth legs of the present species the three claws on the terminal joint are all about the same length and a trifle shorter than those at the outer corners of the second and third joints. Smith makes no mention of the first maxillæ, which are broad and sharp-pointed, with the shape of an equilateral triangle.

PARAPETALUS HIRSUTUS (Bassett-Smith).

Caligus hirsutus BASSETT-SMITH, Ann. and Mag. Nat. Hist., ser. 7, vol. 1, p. 6, pl. 3, figs. 1 and 2.

Plate 33, figs. 28 to 35.

Both sexes of this species were found in the gill cavity of *Polyne-mus tetradactylus* at Bombay, India, by Bassett-Smith and were described by him as a new species of *Caligus*. But they belong to the genus *Parapetalus* rather than *Caligus* for the following reasons: 1. The genital segment is prolonged at the posterior corners into a broad, two-lobed wing, and the sides of the abdomen also are flattened into broad wings. 2. The grooving of the carapace is different from that found in *Caligus*, or in any of the *Caliginæ*, and resembles much more that in the *Euryphorinæ*. 3. The fourth legs are short and thickset, and the three terminal joints are solidly fused and armed with winged spines. 4. The egg strings are long and thread-like, similar to those of *Lernanthropus*, and not at all like the comparatively plump strings of *Caligus* and *Lepeophtheirus*.

Besides locating his specimens in the wrong genus, Smith made several blunders in describing them. Of the female he states "Cephalothorax oval, nearly twice as long as broad, about one-third the

total length" (p. 7). But his figure, as well as the one here published, shows that the cephalothorax is elliptical rather than oval and of nearly the same width and length. A little further on the same page he adds, "Palp at the base of first maxilliped long and sharp." His figure and the one here given show that this "palp" is really the first maxilla and is not connected at all with the "first maxilliped." In describing the fourth legs he states that the last joint has "on its inner border three setæ." In his enlarged figure of these legs he has represented four setæ on the last joint, none on the third joint, and one on the second joint. Of course the setæ are on the outer border instead of the inner, and in the present specimens there are three on the last joint, one on the third, and one on the second, in accordance with his description but at variance with his figure. He says nothing about the egg strings and shows only the stumps of them in his figure. But they are narrow and threadlike and as long as the entire body. The eggs are thin and very similar to those of *Lernanthropus* and other Dichelestiids, and not at all like those of *Caligus*.

In the grooving of the dorsal surface of the carapace the sides of the H are extremely irregular, the lower half being strongly convex outward, while the upper half runs to a notch on either side in the edge of the carapace. This is not like *Caligus*, but does resemble that found in the Euryphorinæ.

The present specimens include two females with egg strings, taken from the same host, *Polynemus tetradactylus*, at Batavia, Java. They have received the catalogue number 42295, U.S.N.M.

LERNANTHROPUS LAPPACEUS, new species.

Plate 34.

Female.—General body form elongate and pear-shaped, considerably widened posteriorly; cephalothorax ovate, one-fifth the entire length, only two-thirds as wide as the remainder of the thorax; carapace projecting strongly at the sides and in front and rolled ventrally over the mouth parts and the first two pairs of swimming legs.

Second and third segments thoroughly fused, with no signs of demarcation, the two together barrel-shaped, with strongly convex sides. Dorsal plate of the fourth segment twice the width of the fused second and third segments, oval in outline, with a squarely truncated posterior margin which considerably overlaps the bases of the egg strings and the fourth and fifth legs.

Fifth segment, genital segment, and abdomen short and broad, but well defined; anal laminæ short, conical, and unarmed. Egg strings narrow and one-third as long again as the entire body; eggs thin, about 150 in each string.

First antennæ short and slender, only partially visible in dorsal view; second pair stout, the basal joint considerably longer than the terminal claw. First maxillæ stout, the terminal joint as thick as the basal and tipped with three spines, the central one of which is longer and stouter than the other two; second maxillæ with a slender terminal claw. Basal joint of the maxillipeds much swollen; terminal claw conical, shorter than the basal joint, and slightly curved.

Exopods of the first two pairs of legs wider than the endopods and considerably flattened. First exopod armed with five short and sharply conical spines; second exopod also with five spines which are narrow and bluntly pointed. Endopods of both pairs with a stout, pear-shaped basal joint about as long as the exopod, and a stout terminal spine half as long again as the basal joint. Third legs of the usual plicate form, short and stout and projecting at right angles to the body axis. Fourth legs projecting half their length behind the posterior margin of the dorsal plate; rami flattened and armed posteriorly around their margins with a broad band composed of rows of papillate processes, each of which bears from three to five short and sharp spines. So far as known no armature of this sort has ever been observed on any other species of the genus. Consequently this character alone will serve to distinguish the present species, since it is very prominent.

Color a brownish-yellow without pigment; egg strings dark cinnamon-brown.

Total length (including fourth legs), 6 mm. Width of fourth dorsal plate, 2.15 mm. Length of cephalothorax, 0.9 mm. Width, 0.9 mm. Length of egg strings, 8 mm.

Male.—General body form oblong, two and a half times as long as wide, somewhat widened posteriorly; cephalothorax nearly circular, a trifle wider than long with the lateral margins flattened; antennal area very short but projecting well laterally. Free thorax, genital segment, and abdomen well fused, without transverse grooves, but with marginal invaginations indicating the segments; genital segment much narrower than the free thorax; anal laminæ narrow, conical, and unarmed. Mouth-parts and legs like those of the female, with these differences: The second antennæ are larger and stouter; the terminal claw of the maxillipeds is relatively longer and more abruptly curved; the third legs are directed diagonally backwards; the spiny processes are lacking on the inner margins of the fourth legs.

Color as in the female, but a little lighter.

Total length (including fourth legs), 2 mm. Width of cephalothorax, 0.51 mm. Width of fourth segment, 0.75 mm.

(*lappaceus*, burrlike, that is, armed with prickles like a burr, alluding to the fourth legs.)

Three females and two males, all excellently preserved, were obtained from the gills of *Polynemus tetradactylus* at Batavia, Java. One female has been numbered 42303, U.S.N.M., and becomes the type of the new species. The other two females and the two males have received the catalogue number 42326, U.S.N.M., and become cotypes.

In addition to the spiny processes this species is further distinguished by the strong narrowing of the cephalothorax and the widening of the fourth dorsal plate. All the specimens of both sexes were found fastened to the outside of the gill filaments, close to the upper end of the gill arch.

EXPLANATION OF PLATES.

PLATE 30.

Male and female of *Argulus ingens*, new species.

- Fig. 1. Dorsal view of male.
 2. First and second antenna of female.
 3. Maxilliped.
 4. Bases of the four pairs of swimming legs of the male, showing accessory sexual organs.
 5. Respiratory areas.
 6. Three of the supporting rods in the edge of the sucking disk.

PLATE 31.

Female of *Argulus ingens*, new species, and male of *Achtheinus pinguis*, new species.

- Fig. 7. Dorsal view of female of *Argulus ingens*.
 8. Dorsal view of male of *Achtheinus pinguis*.
 9. Mouth tube and first maxillæ of the same.
 10. Maxilliped.
 11-14. First, second, third, and fourth swimming legs.

PLATE 32.

Females of *Achtheinus pinguis*, new species, and *Caligus phipsoni* Bassett-Smith.

- Fig. 15. Dorsal view of female of *Achtheinus pinguis*.
 16. Maxilliped of same.
 17-20. First, second, third, and fourth swimming legs.
 21. Ventral view of genital segment and abdomen, showing the cement glands and rudimentary fifth and sixth legs.
 22. Dorsal view of female of *Caligus phipsoni*.

PLATE 33.

Females of *Caligus phipsoni* and *Parapetalus hirsutus* (Bassett-Smith).

- Fig. 23. Second antenna and mouth-parts of *Caligus phipsoni*.
 24. First swimming leg.
 25. Furca.
 26 and 27. Third and fourth swimming legs.
 28. Dorsal view of female of *Parapetalus hirsutus*.
 29. Second antenna, maxillary hook, mouth-tube, and maxilla.
 30. Maxilliped.
 31. Furca.
 32-35. First, second, third, and fourth swimming legs.

PLATE 34.

Male and female of *Lernanthropus lappaceus*, new species.

- Fig. 36. Dorsal view of male.
37. Dorsal view of female.
38. Mouth-parts of male.
39. Maxilliped of female.
40 and 41. First and second swimming legs.
42. Portion of ventral surface of fourth leg enlarged to show the small papillæ armed with sharp spines.